

Effects Of The Robot's Role On Human-Robot Interaction In An Educational Scenario

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Introduction

On the one hand, one of the most valued feedback for students is being respected by their teachers as individuals as opposed to being treated as ignorant. It is for that reason that the latest educational theories suggest the need for a shift of the teacher's role, highlighting the importance of moving from "telling" towards "questioning". A teacher is no longer seen as someone who gives a lecture, but in order to improve the learning processes he also helps and guides the learners to speculate by asking questions. Such pedagogical approach modifies the roles of students and teachers so that their position is equilibrated and the hierarchical differences and boundaries between them decrease.

On the other hand, the increasing potential of social robots leads us to study the possible roles they will play in society as well as the particular functions in fields such as healthcare or education. The use of robots in education has increased in the last years. Different platforms have been used in programming courses or even language acquisition programs. Nevertheless, further investigation of robots as teaching assistants or learning companions is needed to understand their potential in the educational field. Since their design allows for a high level of control, decomposition and manipulation of relevant behavioural cues such as gaze, we hypothesize that robots may present the educational content in a "socially present" manner adaptable to the needs of every individual.

Methodology

The aim of this research is to investigate the differences in knowledge retrieval, subjective experience and behaviour in an educational scenario where in one case a robot plays the role of a teacher and, in the other, of a peer. We hypothesize that the participants in the peer condition will score higher on the knowledge retrieval test and subjective experience questionnaire.

In this experiment, the robot gives a history class of two minutes and a half. The experiment has three conditions: the Teacher condition (TR); the Peer condition (PR); and a Control (C) condition (where the participants listen to the recorded speech of the robot from the TR condition), to assess whether the knowledge acquisition was not simply caused by the spoken contents transfer. The main differences between the TR and PR include the use of formal language, gesturing, and the body posture. The language is more formal in the TR condition as opposed to PR where the robot adds comments about the topic. Regarding the gestures, in the TR condition, the robot only uses illustrative gestures to accompany the verbal message; in the RP condition, the robot uses wider gestures, which are not only illustrative but they also affect displays and regulators. Finally, the robot is always standing in the TR condition; and in the PR condition, it begins the experiment standing and sits after a while. Our sample consisted of 28 adults (age 27.04 ± 6.04 ; 12 female) randomly distributed among three different conditions (TR=10, RP=10, C=8).

	Teacher's Role	Peer's Role	Control
Embodiment	Yes	Yes	No
Speech	Formal	Informal + comments	Formal
Gestures	Minor use	More and wider	-
Proxemics	Standing	Sitting	-

As the experiment takes place in the Poble Nou Campus of the Pompeu Fabra University, the educational topic is the Industrial Revolution in Catalunya and its relation with the Campus. The robot used is the humanoid robot Nao, developed by Alderaban Robotics, which has 25 degrees of freedom and it is equipped with several sensors, which include two cameras, RGB LEDs, and an inertial sensor. During the experiment, the robot is placed in front of the participant, and maintains eye contact with him. We used a video camera to record and analyse the behavior of the subject.

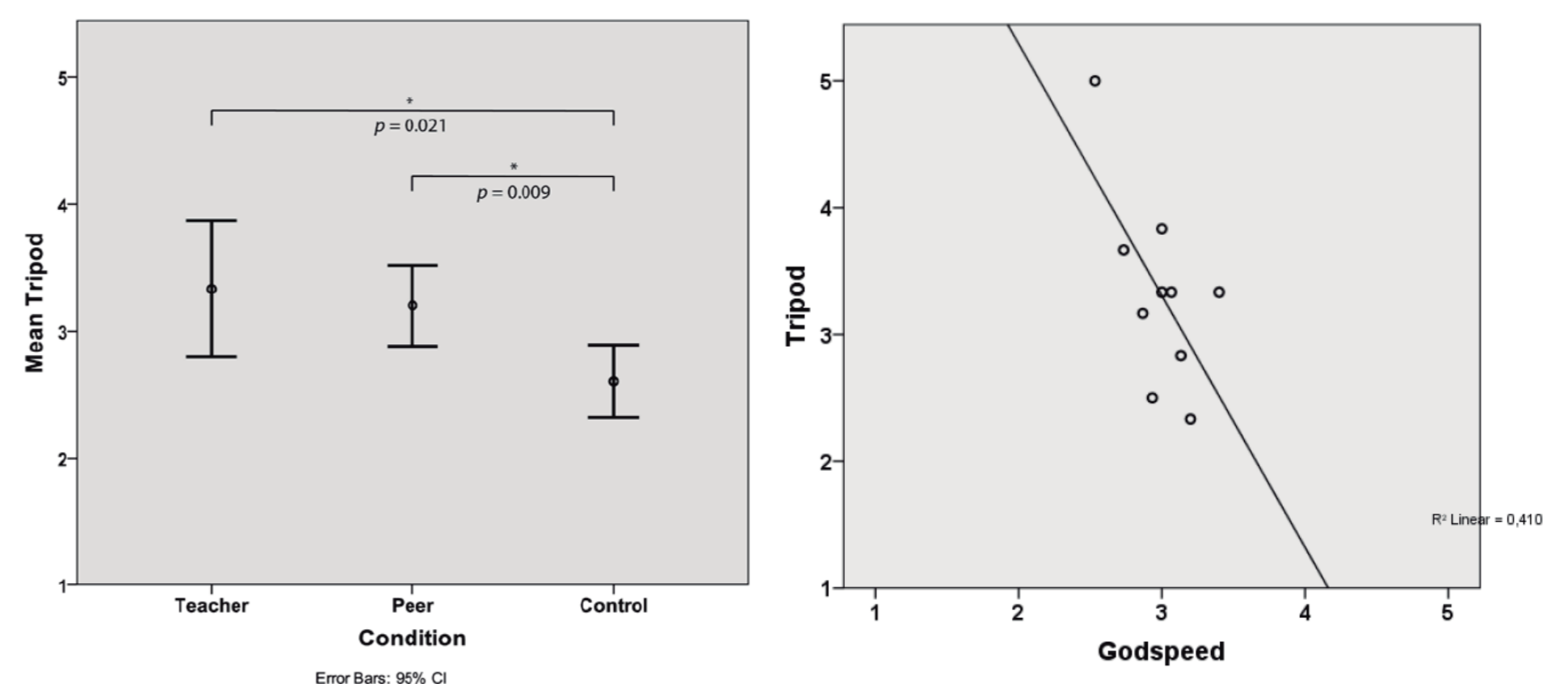
Data were collected from several sources:

- Knowledge questionnaire
- Subjective experience questionnaire:
 - Basic Empathy Scale
 - Godspeed questionnaire
 - Tripod Survey
 - Big Five personality test
- Perception of education questionnaire
- Video recordings

Results

Our preliminary results show significant differences in knowledge retrieval between conditions. A general significant improvement was found, but the data are not sufficient to draw conclusions about which specific parameters accounted for the knowledge retrieval. Interestingly, we note that as the differences between conditions for the knowledge improvement increase together with the number of subjects. Further experiments need to be performed to systematically investigate whether this trend has significant implications.

Among other significant results, there was statistically significant difference among conditions in the Tripod part of the Subjective Experience questionnaire ($p = 0.021$), which was significantly negative correlated with the results of the Godspeed questionnaire ($p = 0.046$).



Discussion and Conclusion

No significant differences were found between the roles of the robot in the Subjective Experience questionnaire. Nevertheless, non-expected behaviors towards the robot appeared in the PR condition. Novelty can lead the users to focus more on the robot itself than on the topic of the lesson. This was reported by some participants, who claimed to have been so engaged and enthusiastic that sometimes they were more focused on the robot than on what it was saying. A long-term study may be needed to test the evolution of knowledge retrieval where the subjective experience of the users after the novelty threshold diminishes.

Moreover, further steps in this research will be performed, like adding a new condition where the robot can recognize the speech of the subject. As for our pilot study, further analysis of the behavioral data can provide insights regarding eye contact.

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This work is supported by the EU FP7 project WYSIWYD (FP7-ICT-612139) and EASEL (FP7-ICT- 611971).